

**What is claimed is:**

- 1        1.    A method for rounding the top corner of a trench,  
2    comprising the steps of:  
3        forming a masking layer overlying a substrate;  
4        patterning the masking layer to form at least one  
5        opening therein to expose the substrate and form  
6        a recess region in the substrate;  
7        oxidizing the recess region to form a first oxide layer  
8        thereon to round the top corner of the recess  
9        region;  
10       successively etching the first oxide layer and the  
11       substrate under the opening to form the trench in  
12       the substrate; and  
13       conformably forming a second oxide layer on the surface  
14       of the trench.
- 1       2.    The method as claimed in claim 1, wherein the  
2    masking layer comprises a pad oxide layer and a silicon  
3    nitride layer thereon.
- 1       3.    The method as claimed in claim 1, wherein the step  
2    of patterning the masking layer further comprises:  
3        successively forming a boron silicate glass layer and a  
4        photoresist layer on the masking layer;  
5        patterning the photoresist layer to form at least one  
6        second opening therein to expose the boron  
7        silicate glass layer;  
8        etching the exposed boron silicate glass layer to  
9        expose the masking layer;

10 removing the patterned photoresist layer; and  
11 etching the masking layer using the boron silicate  
12 glass layer as a mask.

1 4. The hard mask structure as claimed in claim 1,  
2 further removing a portion of the opening in the sidewall of  
3 the masking layer before the second oxide layer is formed.

1 5. The method as claimed in claim 4, wherein the  
2 portion of the opening sidewall of the masking layer is  
3 removed by hydrofluoric acid (HF) or ethylene glycol (EG)  
4 solution.

1 6. The method as claimed in claim 1, wherein the  
2 recess region has a depth of about 10 to 300Å.

1 7. The method as claimed in claim 1, wherein the  
2 recess region is oxidized by rapid thermal oxidation.

1 8. The method as claimed in claim 7, wherein the  
2 recess region is oxidized at a temperature of about 950 to  
3 1200°C.

1 9. The method as claimed in claim 7, wherein the  
2 recess region is oxidized for 20 to 60sec.

1 10. The method as claimed in claim 1, wherein the  
2 first oxide layer has a thickness of about 70 to 100Å.

1 11. The method as claimed in claim 1, wherein the  
2 second oxide layer is formed by thermal oxidation.

1 12. The method as claimed in claim 1, wherein the  
2 second oxide layer has a thickness of about 110 to 140Å.

1        13. A method for forming a shallow trench isolation  
2 structure, comprising the steps of:

3        successively forming a pad oxide layer, a silicon  
4        nitride layer, and a boron silicate glass layer  
5        overlying a substrate;

6        successively etching the boron silicate glass layer,  
7        the silicon nitride layer, and the pad oxide  
8        layer to form at least one opening therein to  
9        expose the substrate and form a recess region in  
10       the substrate;

11       oxidizing the recess region by thermal oxidation to  
12       form a first oxide layer thereon to round the top  
13       corner of the recess region;

14       successively etching the first oxide layer and the  
15       substrate under the opening to form a trench in  
16       the substrate;

17       conformably forming a second oxide layer on the surface  
18       of the trench; and

19       filling the trench with an insulating layer to form the  
20       shallow trench isolation structure.

1        14. The method as claimed in claim 13, before forming  
2 the second oxide layer, further comprising the step of:

3        removing the boron silicate glass layer; and

4        removing a portion of the opening in the sidewalls of  
5        the silicon nitride layer and the pad oxide  
6        layer.

1        15. The method as claimed in claim 14, wherein the  
2 portion of the opening in the sidewalls of the silicon

3 nitride layer and the pad oxide layer is removed by  
4 hydrofluoric acid or ethylene glycol solution.

1 16. The method as claimed in claim 13, wherein the  
2 recess region has a depth of about 10 to 300Å.

1 17. The method as claimed in claim 13, wherein the  
2 recess region is oxidized at a temperature of about 950 to  
3 1200°C.

1 18. The method as claimed in claim 13, wherein the  
2 recess region is oxidized for 20 to 60sec.

1 19. The method as claimed in claim 13, wherein the  
2 first oxide layer has a thickness of about 70 to 100Å.

1 20. The method as claimed in claim 13, wherein the  
2 second oxide layer has a thickness of about 110 to 140Å.